

**UNITED STATES PATENT AND TRADEMARK OFFICE**

**PATENT**

Applicant: Robert E. Higashi et al.  
Serial No.: 10/750,581  
Filed: December 29, 2003  
For: MICRO FUEL CELL  
Docket No.: H0005015-1100.1237101

Confirmation No.: 8573  
Examiner: Alix Echelmeyer  
Group Art Unit: 1745  
Customer No.: 90545

**SUPPLEMENTAL DECLARATION UNDER 37 C.F.R. § 1.131**

Mail Stop Amendment  
Commissioner for Patents  
P.O. Box 1450  
Alexandria, VA 22313-1450

**CERTIFICATE OF ELECTRONIC TRANSMISSION**

I hereby certify that this paper is being electronically transmitted to the United States Patent and Trademark Office on the date shown below.

Lynn Thompson      2-8-11  
Lynn Thompson      Date

We, Robert E. Higashi, Khanh Q. Nguyen, Karen M. Newstrom-Peitso, Tom K. M. Rezachek, and Roland A. Wood, as the inventors of the claimed invention of the above-identified application, declare as follows:

This Declaration is to establish completion of the invention in the above-identified application in the United States at a date prior to April 30, 2003.

**Facts and Documentary Evidence**

All work on the invention included in the above-identified application was completed in the United States.

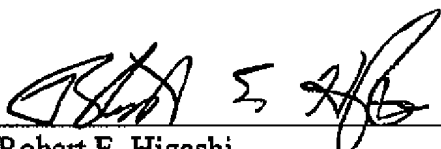
The invention of the above-identified patent application was completed prior to April 30, 2003. As evidence of this, attached hereto as Exhibit 2 are true and accurate copies of certain pages from a report entitled "AMPGen: Active Micro Power Generator", with dates removed. From the dates set forth on the AMPGen report (which have been redacted from the attached

copy), we can tell that the fuel cell shown in FIG. 9 was made and tested prior to April 30, 2003. The fuel cell shown in FIG. 9 was made in accordance with the instantly claimed invention and was tested and found suitable for its intended purpose as shown in FIG. 10. The report shows that the invention of the above-identified patent application was completed prior to April 30, 2003.

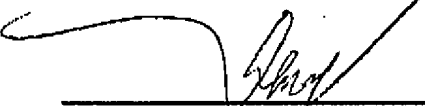
We hereby declare that all statements made herein are of my own knowledge and are true and all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Respectfully submitted,

Date: 2/2/11

  
Robert E. Higashi


Date: 2-FEB-2011

  
Khanh Q. Nguyen

Date: 2/2/11

  
Karen M. Newstrom-Peitso

Date: 2/3/11

  
Tom R. Rezachek  
M. R.

Date: \_\_\_\_\_

\_\_\_\_\_  
Roland A. Wood

copy), we can tell that the fuel cell shown in FIG. 9 was made and tested prior to April 30, 2003. The fuel cell shown in FIG. 9 was made in accordance with the instantly claimed invention and was tested and found suitable for its intended purpose as shown in FIG. 10. The report shows that the invention of the above-identified patent application was completed prior to April 30, 2003.

We hereby declare that all statements made herein are of my own knowledge and are true and all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Respectfully submitted,

Date: \_\_\_\_\_

\_\_\_\_\_  
Robert E. Higashi

Date: \_\_\_\_\_

\_\_\_\_\_  
Khanh Q. Nguyen

Date: \_\_\_\_\_

\_\_\_\_\_  
Karen M. Newstrom-Peitso

Date: \_\_\_\_\_

\_\_\_\_\_  
Tom R. Rezachek

Date: 2/2/2011

Roland A Wood  
Roland A. Wood

Exhibit 2

# **AMPGen: Active Micro Power Generator**

**Contract Number F33615-01-C-2171**

**Quarterly Status Report for the Period ending**

**CDRL Data Item A007**

**Preparation Date:**

**Prepared By:**

**Honeywell Laboratories**

**12001 State Highway 55**

**Plymouth, MN 55441-4799**

**Andrew Wood, Principal Investigator**

**Phone 763-954-2799 Fax 763-954-2504 andrew.wood2@honeywell.com**

**For:**

**Air Force Research Laboratory**

**2310 8th Street**

**Wright Patterson AFB, OH 45433-7801**

\_\_\_\_\_  
**Dr. R A Wood**  
**Principal Investigator**

\_\_\_\_\_  
**Dr. Cleo Cabuz**  
**MicroDevices Laboratory Manager**

**UNCLASSIFIED**

**Distribution authorized to U.S. Government Agencies only. Other requests shall be referred to:**

**Air Force Research Laboratory**  
**2310 8th Street**  
**Wright Patterson AFB, OH 45433-7801**

**(\*) This report also constitute a semiannual report for the period ending**

- Ambient temperature was  $28 \pm 0.5$  °C and relative humidity  $49 \pm 2$  %.
- 99.999 % pure non-humidified hydrogen was used.

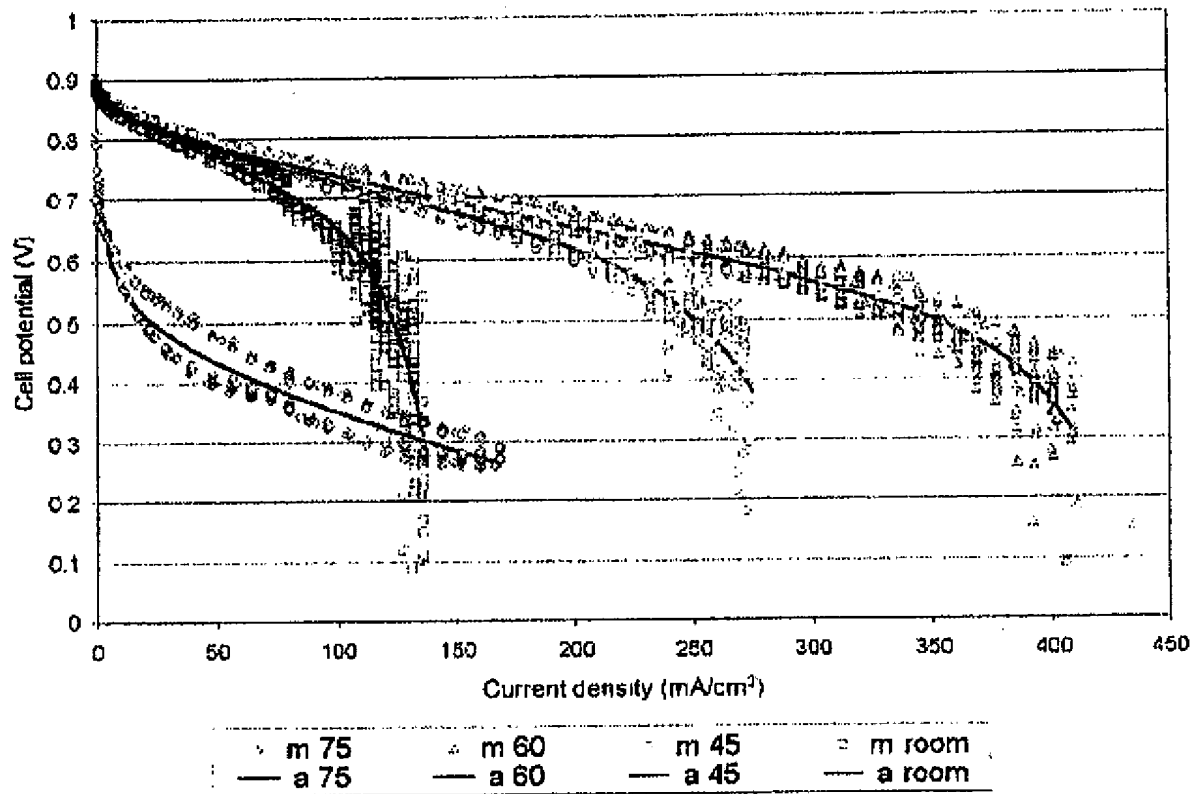


fig 8. experimental data on fuel cell operation with dry hydrogen.

At a temperature of -10°C and -25°C dew point the conductance of Nafion has been measured (T Reitz communication) to be 1.8mS/cm. Thus a Nafion PEM 1 mil thick and 1mm² area would have an electrical resistance of  $1/1.8 \times 10^{-3} \times 25 \times 10^{-4} / 0.01 = 140$  Ohms, and a current density of 10mA/cm² would produce an Ohmic voltage drop across the PEM of 14mV, a negligible voltage loss. Thus the prospects are quite encouraging that AMPGen modules will operate well below the freezing point of water.

To obtain practical experience with fuel cells operating with dry hydrogen at low temperatures, a fuel cell was constructed, shown in fig 9. The PEM was Nafion™ lot number W37385AB, 40µm thickness, 2mm diameter, with carbon electrodes with 0.3mg/cm² Pt, cost 55 cents per cm², supplied by Ion Power Inc ([www.ion-power.com](http://www.ion-power.com)). The electrodes were aluminized mylar with an adhesive surface. One side of the fuel cell

was exposed to a slowly flowing stream of dry hydrogen, and the other side was open to the laboratory room air. The fuel cell produced an open circuit voltage of about 0.75V and maintained that for a period of a few days, the duration of the test. The V-I characteristic is shown below. It can be seen that the goal current density (about 10mA/cm<sup>2</sup>) was achieved.

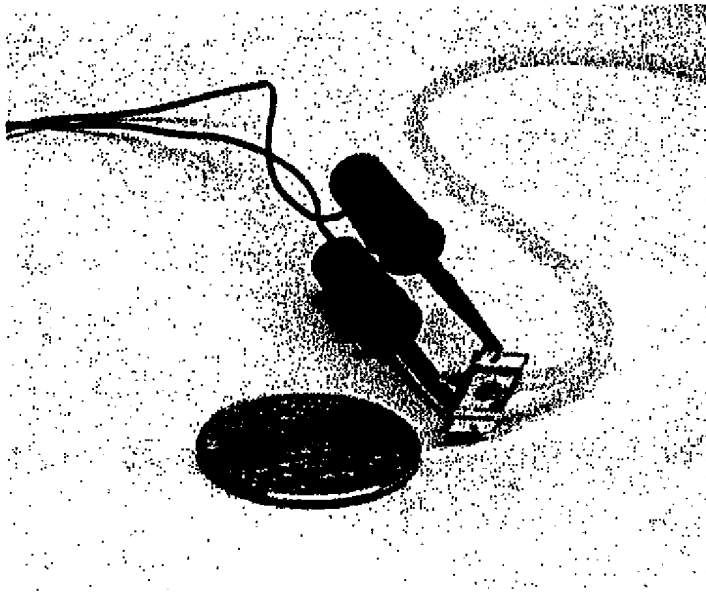


fig 9 prototype fuel cell (since PEM cell 2mm diameter). Dry hydrogen flows slowly along the gas line which leads past one side of the PEM. The other side of the PEM (dark circular area) is open to laboratory air.

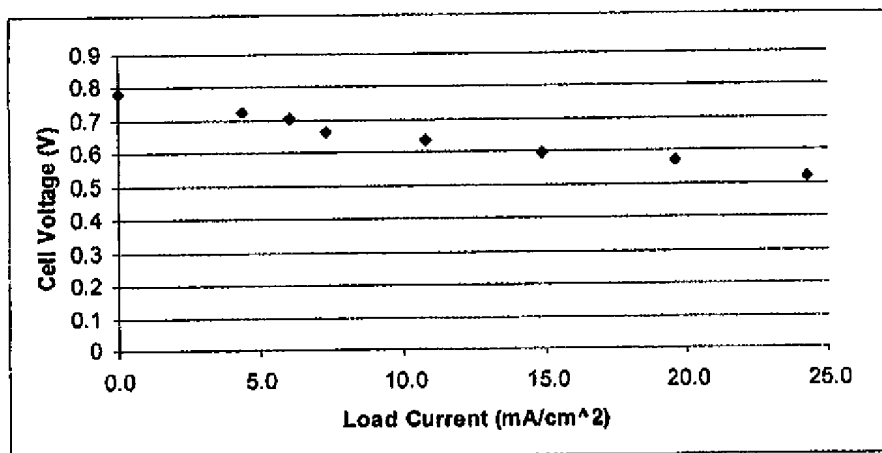


fig 10. Measured V-I characteristic of the fuel cell of fig 5. AMPGen requirement is about 0.6V at about 10mA/cm<sup>2</sup>.

**UNITED STATES PATENT AND TRADEMARK OFFICE**

Applicant: Robert E. Higashi et al.  
Serial No.: 10/750,581  
Filed: December 29, 2003  
For: MICRO FUEL CELL  
Docket No.: H0005015-1100.1237101

Confirmation No.: 8573  
Examiner: Alix Echelmeyer  
Group Art Unit: 1745

**DECLARATION UNDER 37 C.F.R. § 1.131**

Mail Stop Amendment  
Commissioner for Patents  
P.O. Box 1450  
Alexandria, VA 22313-1450

**CERTIFICATE FOR ELECTRONIC TRANSMISSION:**

The undersigned hereby certifies that this paper or papers, as described herein, are being electronically transmitted to the U.S. Patent and Trademark Office on this 11th day of March 2010.

By Lynn Thompson  
Lynn Thompson

We, Robert E. Higashi, Khanh Q. Nguyen, Karen M. Newstrom-Peitso, Tom R. Rezachek, and Roland A. Wood, as the inventors of the claimed invention of the above-identified application, declare as follows:

This Declaration is to establish completion of the invention in the above-identified application in the United States at a date prior to April 30, 2003.

**Facts and Documentary Evidence**

All work on the invention included in the above-identified application was completed in the United States.

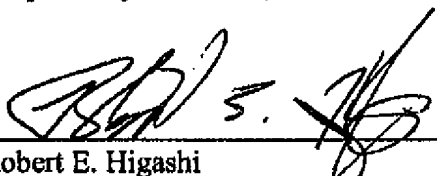
The invention of the above-identified patent application was completed prior to April 30, 2003. As evidence of this, attached hereto as Exhibit 1 is a true and accurate copy of Honeywell Invention Disclosure Number "H0005015", entitled "Low Cost Micro-Fuel Cell", with only the dates removed. From the dates set forth on Honeywell Invention Disclosure Number

"H0005015" (which have been redacted from the attached copy), I can tell that this Invention Disclosure Record was prepared and submitted prior to April 30, 2003. The Invention Disclosure Record shows that the invention of the above-identified patent application was completed prior to April 30, 2003.

We hereby declare that all statements made herein are of my own knowledge and are true and all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Respectfully submitted,

Date: 7-15-09

  
Robert E. Higashi

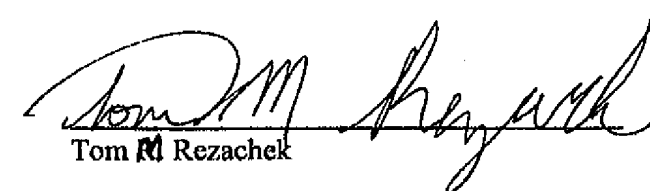
Date: 7-15-09

  
Khanh Q. Nguyen

Date: 7-15-09

  
Karen M. Newstrom-Peitso

Date: 7/21/09

  
Tom M Rezachek

Date: \_\_\_\_\_

\_\_\_\_\_  
Roland A. Wood



"H0005015" (which have been redacted from the attached copy), I can tell that this Invention Disclosure Record was prepared and submitted prior to April 30, 2003. The Invention Disclosure Record shows that the invention of the above-identified patent application was completed prior to April 30, 2003.

We hereby declare that all statements made herein are of my own knowledge and are true and all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Respectfully submitted,

Date: \_\_\_\_\_

\_\_\_\_\_  
Robert E. Higashi

Date: \_\_\_\_\_

\_\_\_\_\_  
Khanh Q. Nguyen

Date: \_\_\_\_\_

\_\_\_\_\_  
Karen M. Newstrom-Peitso

Date: \_\_\_\_\_

\_\_\_\_\_  
Tom R. Rezachek

Date: July 23<sup>rd</sup> 2009

Roland A Wood  
Roland A. Wood

# EXHIBIT I

Honeywell CONFIDENTIAL  
ATTORNEY-CLIENT PRIVILEGED

Invention Record  
(Docket) No.:  
H0005015

Origin Date: SBE: 0760 - ACS - Advanced Technology Labs

Attorney(s): Fredrick, Kris T

File Location: GV - Golden Valley, MN

Title: Low cost micro-fuel cell

Inventor: Higashi, Robert E  
Address: 20220 Manor Road, Shorewood, MN 55331  
Phone: 763-954-2784 Fax: 763-954-2504  
Citizenship: USA

SSN: \*\*\*\*\*  
County: Hennepin  
Supervisor: Cleopatra Cabuz

Inventor: Nguyen, Khanh Q  
Address: 1716 E 88th St, Bloomington, MN 55425  
Phone: 952-854-5386 Fax: 763-954-2389  
Citizenship: USA

SSN: \*\*\*\*\*  
County: Hennepin  
Supervisor: Cleo Cabuz

Inventor: Newstrom-Peltso, Karen M.  
Address: 25 Monroe Avenue South, Hopkins, MN 55343  
Phone: 763-954-2680 Fax: 763-954-2713  
Citizenship: USA

SSN: \*\*\*\*\*  
County: Hennepin  
Supervisor: Cleo Cabuz

Inventor: rezachek, tom r  
Address: home, city, mn 55455  
Phone: 763 954 2787 Fax: 763 954 2504  
Citizenship: usa

SSN: \*\*\*\*\*  
County: county  
Supervisor: arch

Inventor: Wood, Roland A  
Address: 150 Mission Lane East, Bloomington,  
MN 55420  
Phone: 763-954-2799 Fax: 763-954-2504  
Citizenship: USA

SSN: \*\*\*\*\*  
County: Hennepin  
Supervisor: C. Cabuz

1. Briefly describe the technical or commercial problem or need that this invention is intended to solve.  
There are many applications requiring low power, long life, small size power sources such as wireless sensors. Simple batteries work well, are only rated for a 5 year life. Fuel cells are well suited for these markets, but most emphasis has been on making large cells, and in general fabrication costs of large devices has been high.

2. Briefly describe how this invention solves the problem or meets the need.  
This device would be easily fabricated in roll-to-roll or large sheet batch methods for low cost and could be combined with powder/water hydrogen sources to produce electrical power.

3. Describe how to make and use the invention. Please indicate which embodiment(s) are preferred and describe the best way known to you to practice the invention. Attach relevant documents. (If the invention is a device or process, please provide a drawing or flow chart.) (If you are unfamiliar with the contents and preparation of a patent application, please refer to the Guidelines for the Preparation of Invention Disclosures.  
Four embodiments of how to make the device are illustrated in the attachment  
Document(s):  
H0005015\_MU1\_January 17-fuel cell meeting notes.doc

4(a). To the best of your recollection what is the earliest date on which the invention was conceived? Who

conceived the invention? Attach documents which evidence the foregoing.

Conception Date:

Who conceived it?: Tom Rezachek, Andrew Wood, Karen Newstrom-

Peitso,

Document(s):

---

4(b). Is there a non-inventor who witnessed the conception? If so, please identify him/her and attach any documents which evidence the witnessing.

no

Witness Name:

Witness Phone: First Practice Documents:

---

5(a). To the best of your recollection, what is the earliest date on which the invention was reduced to practice (i.e. made)? Who reduced the invention to practice. Attach documents which evidence the foregoing. If no reduction to practice, type "n/a".

First Practice Documents:

First Practice Date: n/a

Who reduced it to practice?:

---

5(b). Is there a non-inventor who corroborated the reduction to practice? If so, please identify him/her, the corroborating activity (i.e., over-the-shoulder corroboration or repeating the experiment), and the date of the activity. Attach documents which evidence the foregoing.

Non-inventor corroborator?:

First Corroborator

First Corroborator Phone:

no

Name:

First Practice

Corroboration Date:

First Practice Corroborator Activity:

Document(s) related to corroboration event:

---

5(c). For each example of the invention and each comparative example on which you intend to rely in the patent application, please indicate when the example was generated, who conducted the experiment and where this example is recorded (e.g., volume, page and author or laboratory notebook) and attach a copy of these records. If no example available, type "n/a".

Example(s):

Example Date:

Who conducted the experiment?:

Where is example recorded?:

---

6(a). Did this invention arise in a program that is funded in whole or part by the U.S. Government or another company, or any entity other than Honeywell?

Yes

---

6(b). If so, please identify the program (including government contract number, if applicable) and the entity sponsoring the program and provide a copy of any agreement between the parties concerning the program.

Outside Funding Program: AMPGEN

Contract Number (if applicable): F33615-01-2171

Outside Funding Entity: DARPA

Document(s) related to funding agreement:

---

7(a). To your knowledge, is this invention subject to any agreement between Honeywell and a third party (e.g., a secrecy agreement, license agreement, joint development agreement, etc.)?

no

7(b). If so, please identify the agreement and the other party and attach a copy of the agreement if one is available.

Third party agreement ID:

Third party name:

Document(s) related to any third party agreement:

8. You have a duty to disclose to the U.S. Patent and Trademark Office all relevant prior art of which you are aware. Please list all such prior art (e.g., patents, publications, brochures, Honeywell and third-party products) known to you. If a prior art search has been conducted, it must be included. Briefly indicate how this invention is different from the prior art. See 1 and 2 above.

List of prior art:

How invention is different from the prior art:

9(a). Has the product or process which is the subject of this invention disclosure been disclosed, sold or offered for sale to anyone outside of Honeywell or to the general public.

no

9(b). If so, when and to whom was it disclosed, sold or offered for sale? If it was disclosed, was a secrecy agreement in place? Attach documents which evidence the sale or offer for sale.

Date it was disclosed:

Whom disclosed to:

Disclosure Sales Agreement?:

Document(s) which evidence the sale or offer for sale:

9(c). Does the business intend to disclose, sell or offer to sell the invention to anyone outside of Honeywell or to the general public in the near future? If so, to whom and when is this disclosure, sale or offer for sale planned?

For whom are future sales planned:

Date future sale is planned:

10(a). Does this invention relate to any other: (i) issued patents, (ii) pending patent applications, or (iii) previously submitted invention disclosures, of Honeywell?

10(b). If so, please identify the related matter and indicate whether this is an improvement on an earlier invention: Other patents related matter is:

Is this an improvement?:

11. Please specify the product(s) to which this invention disclosure relates.

12. Please indicate keywords for identifying this invention disclosure.

Witness

Inventor

Name: \_\_\_\_\_

Name: \_\_\_\_\_

Witness  
Signature: \_\_\_\_\_Inventor  
Signature: \_\_\_\_\_

Date: \_\_\_\_\_

Date: \_\_\_\_\_

Inventor  
Name: \_\_\_\_\_Inventor  
Name: \_\_\_\_\_Inventor  
Signature: \_\_\_\_\_Inventor  
Signature: \_\_\_\_\_

Date: \_\_\_\_\_

Date: \_\_\_\_\_

Inventor  
Name: \_\_\_\_\_Inventor  
Name: \_\_\_\_\_Inventor  
Signature: \_\_\_\_\_Inventor  
Signature: \_\_\_\_\_

Date: \_\_\_\_\_

Date: \_\_\_\_\_

Inventor  
Name: \_\_\_\_\_Inventor  
Name: \_\_\_\_\_Inventor  
Signature: \_\_\_\_\_Inventor  
Signature: \_\_\_\_\_

Date: \_\_\_\_\_


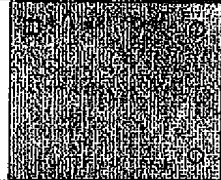
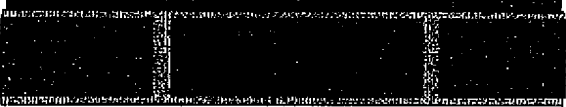
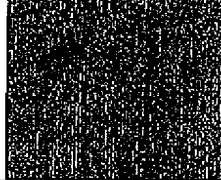

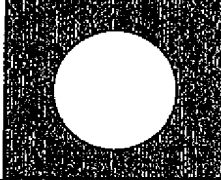

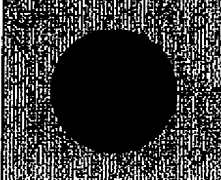

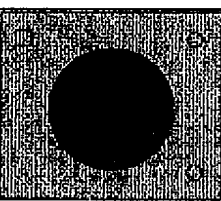
Date: \_\_\_\_\_

Send to:  
Kris T Fredrick  
1985 Douglas Drive N.  
Golden Valley, MN 55422-3992  
*The attorney assigned to this disclosure.*

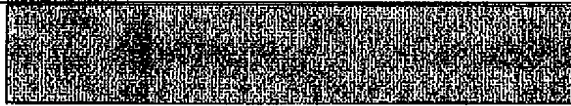
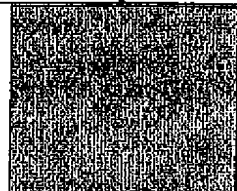

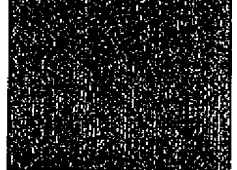


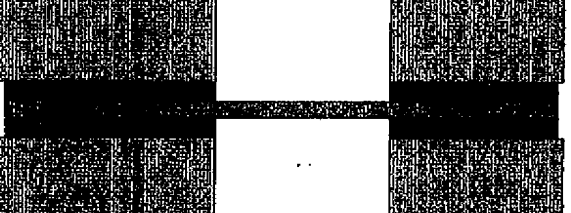
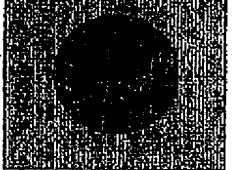

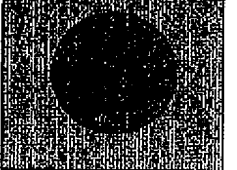
Tom, Andrew, Karen, Khanh and Barry:

Here is a summary of the outputs of our design/process meeting today and some follow up discussions. Four process options were created which should result in very low production cost miniature fuel cells.

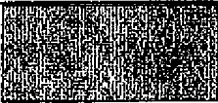
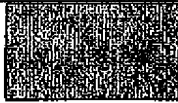
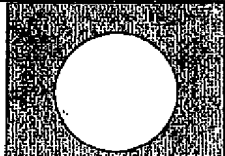


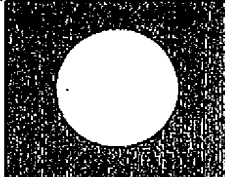
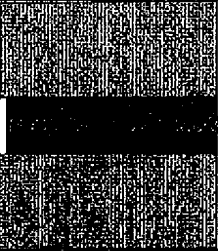

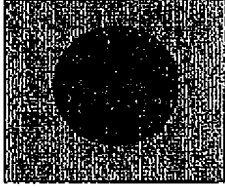
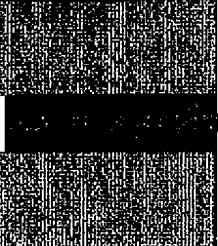

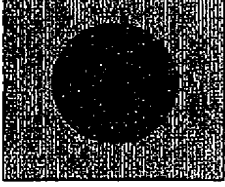
**Process 1: Flexcircuit-A**

<b>Process Step</b>	<b>side view</b>	<b>top view</b>
metallized kapton with feedthrough contacts		
apply conductive adhesive in soft-cure state		
Laser machine openings through stack to complete electrode sheet.		
Laminate PEM between two sheets of finished		
Dice fuel cells by laser or physical cutting (shears)		

## Process 2: Foil-A



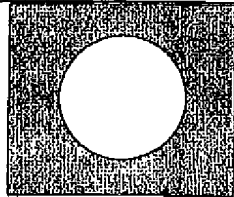


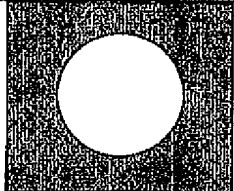
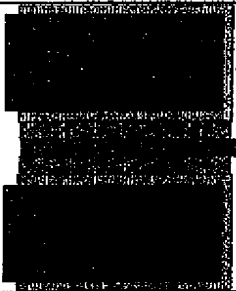

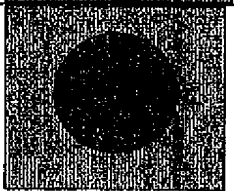
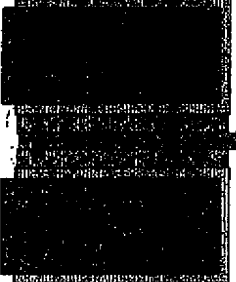

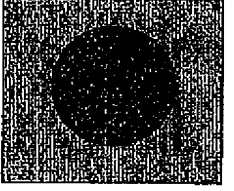
Process Step	side view	top view
metal foil (lead frame?) like gold plated kapton		
Apply conductive- adhesive		
Laser machine holes through adhesive & substrate to complete electrode sheet		
Laminate PEM between two sheets of finished electrodes		
Dice fuel cells by laser or physical cutting (shears)		

### Process 3: Foil-B

Process Step	side view		top view
metal foil (lead frame?) with punched holes			
Roller application of conductive adhesive			
Laminate PEM between two sheets of finished electrodes			
Dice fuel cells by laser or physical cutting (shears)			



#### Process 4: Flexcircuit- B

Process Step	side view		top view
Get kapton with large hole cut and feedthrough contact "plated"			
Roller application of conductive adhesive			
Laminate PEM between two sheets of finished electrodes			
Dice fuel cells by laser or physical cutting (shears)			

These four techniques constitute some of the ways in which batch, roll to roll fuel cell fabrication might be addressed.

Contributors to this discussion include:

Tom Rezachek, Andrew Wood, Khanh Nguyen, Karen Newstrom, Bob Higashi and Barry Cole. Steve Eickhoff was present in the meeting, but I'm not sure if he contributed.